

embodiments, the control mode change request may include an indication of a cause or reason for the control mode change request.

[0209] FIG. 20 illustrates a block diagram of a further example of a method for transferring control of an unmanned aerial vehicle (UAV) to an unmanned aerial system (UAS) traffic management system (UTM), in some embodiments. The method shown in FIG. 20 may be used in conjunction with any of the systems, methods, or devices shown in the Figures, among other devices. In various embodiments, some of the method elements shown may be performed concurrently, in a different order than shown, or may be omitted. Additional method elements may also be performed as desired. As shown, this method may operate as follows.

[0210] At **2002**, a UAV and/or a UAC, such as such as UAV **132** and/or UAC **122**, may send (e.g., transmit) tracking information associated with the UAV and/or UAC to a network entity, such as AMF **704**. In some embodiments, the network entity may forward the tracking information to a UTM, such as UTM **108**. In some embodiments, the tracking information may include at least a UAV identifier (UAV ID) associated with the UAV and/or a UAC identifier (UAC ID) associated with the UAC. In some embodiments, the UAV may be in a first control mode in which a UAC controls the UAV via a cellular radio access network (RAN), e.g., such as a 5G RAN. In some embodiments, the first control mode may be a Network-Assisted control mode. In some embodiments, the UTM may be implemented by a computer system, e.g., a server, or in “the cloud” outside of (e.g., “behind”) the cellular network, e.g., the radio access network. Thus, a server may implement UTM (UAS Traffic Management) functionality (which may be a combination of hardware and software) for coordinating operation and data traffic between one or more of the UAVs and one or more of the UAV controllers. It is noted that each cellular network provider may implement its own UTM. In some embodiments, the tracking information may be and/or include at least one of periodic tracking information and/or event tracking information.

[0211] In some embodiments, periodic tracking information may include at least one of (and/or any of, any combination of, and/or all of) UAV navigational properties, a cell identifier associated with the UAV, a tracking area code (TAC) identifier associated with the UAV, and/or global positioning system (GPS) information associated with the UAV. In some embodiments, UAV navigational properties may include one or more of (and/or any of, any combination of, and/or all of) UAV speed, UAV orientation, and/or UAV altitude. In some embodiments, GPS information may include one or more of (and/or any of, any combination of, and/or all of) a current position or location of the UAV and/or a destination location or destination coordinates of the UAV. In some embodiments, the periodic tracking information may further include at least one of (and/or any of, any combination of, and/or all of) a C2 link communication quality as reported by one of the UAV or UAC, a radio frequency measurement report as measured by one of the UAV or UAC, and/or radio resource control (RRC) status of the UAC.

[0212] In some embodiments, event tracking information may include a C2 communication mode change request and/or a cause code associated with the C2 communication mode change request. In some embodiments, the cause code

may include at least one of (and/or any of, any combination of, and/or all of) a UAC control release cause code, a UAC control suspend cause code, a UAC control resume cause code, and/or a UAC lost cause code. In some embodiments, the UAC control release cause code may be associated with a power level of the UAC dropping below a threshold. In some embodiments, the UAC control suspend cause code may be associated with the UAC detecting and/or determining entry of the UAV into a designated area. In some embodiments, UTM-Navigated control mode may be required while in the designated area. In some embodiments, the UAC control resume cause code may be associated with the UAC detecting and/or determining exiting of the UAV from a designated area. In some embodiments, the UAC lost cause code may be associated with the UAV not receiving any C2 commands from the UAC within a specified period of time.

[0213] At **2004**, the UAV and/or UAC may receive a control mode change request from the network entity. In some embodiments, the control mode change request may be forwarded by the network entity on behalf of the UTM (e.g., the UTM may send the control mode change request to the network entity and the network entity may forward the control mode change request to the UAV and/or UAC). In some embodiments, the UTM may determine to switch the UAV from the first control mode to a second control mode, e.g., based on the tracking information. In some embodiments, the second control mode may include the UTM providing navigational control of the UAV. In some embodiments, the second control mode may be a UTM-Navigated control mode. In some embodiments, the UTM may send, based on a prior request, the tracking information associated with the UAV to a Third-Party Authorized Entity (TPAE) and receive, from the TPAE, the control mode change request. In some embodiments, the TPAE may be implemented by a computer system, e.g., a server, or in “the cloud” outside of (e.g., “behind”) the cellular network and/or outside of (e.g., “behind”) the UTM. Thus, a server may implement TPAA functionality (which may be a combination of hardware and software) for coordinating operation and data traffic between one or more of the UAVs and one or more of the UAV controllers, e.g., via instructions provided to a UTM.

[0214] In some embodiments, the UTM may determine to switch the UAV from first control mode to the second control mode based on determining that the UAV is entering a designated area. In some embodiments, UTM-Navigated control mode may be required while in the designated area. In some embodiments, the designated area is specified by at least one of an air traffic control policy or a government policy.

[0215] In some embodiments, the UTM may determine to switch the UAV from first control mode to the second control mode based on determining that the UAC is unable to communicate with the UAV. In some embodiments, the UTM may determine to switch the UAV from first control mode to the second control mode based on determining that the UAC is initiating the switch based on at least one of a UAC control release cause code and/or a UAC control suspend cause code. In some embodiments, the UTM may determine to switch the UAV from first control mode to the second control mode based on determining that the UAV is initiating the switch based on a UAC lost cause code.